

## Plant Geography

Foundations of Plant Geography. By Stanley A. Cain. xiv + 556 pages. Harper and Brothers. 1944. \$5.00.

The spirit of science demands that every theory be forced to justify its existence and that our philosophy be constantly revised that it may always be in keeping with the advances in our knowledge. "The Foundations of Plant Geography" by Stanley A. Cain attempts to reconcile the thinking in plant geography to the very great advances in our knowledge in the several contributing fields, and surveys the research methods in these fields. There is brought together in one volume a mass of material representing the significant thought on all sides of the many problems bearing on the dynamics of plant distribution. In some instances the author writes as an able reporter, in other instances he chooses to comment upon or synthesize and review the subject matter. Much of this is done superbly and with a clarity that enables one to evaluate as never before the scientific worth of many of our ideologies.

The work is divided into five parts, each dealing with a distinct approach to research in plant geography. Part one attempts to orient the reader and present a résumé of previous expositions of the principles of plant geography; part two deals with what the author terms paleoecology; part three is termed "areography" and concerns spacial distribution and restriction; part four treats evolution and speciation and part five elaborates the inter-relations of polyploidy and plant geography. There is no attempt at floristic description. The work aims solely at elucidating the principles underlying the dynamics of plant geography.

By way of orientation the author refers in his introduction to "descriptive plant geography" and to "interpretive plant geography." The first of these is static and furnishes a part of the materials for the second which is dynamic. The rest of the materials of interpretive geography result from integration and synthesis of the more specialized fields of botany. In addition, "physiological plant geography" is frequently mentioned in the text. Apparently the author prefers to give this subject no "more than incidental mention." In many respects this is unfortunate as some of the criticism I would make of the work hinges upon problems that are physiological in scope or in implication.

In dealing with some previously proposed principles of plant geography and again, in discussing migration and the evolution of vegetation, the author becomes involved between two diametrically opposed concepts as to the relative significance of the means and the extremes of environmental factors in controlling the distribution of plants. According to the author, Clements maintains that the means are more significant than the extremes, whereas Mason (your reviewer) maintains that "in any given region the extremes may be more significant than the means." In attempting to resolve these divergent points of view,

the author finds himself in the awkward position of, on the one hand, agreeing with Mason and not refuting Clements, and on the other hand agreeing with Clements and not refuting Mason. The extreme is the maximum or minimum of an environmental factor beyond which functioning ceases. The mean is an abstraction pure and simple and cannot directly enter any equation of stimulus and response in the physiology of the plant. Under no circumstances is it an environmental factor. The author maintains that Clements' view is to be used "with a long time point of view and with whole associations being considered," while Mason's view is useful when individual organisms in the margin of their range are being considered. He points to the migration of the redwood forest through time as being under the influence of the migration of the mean. He admits, however, that this migration is initiated as a function of the extremes acting upon individuals. The species of the flora moved forward with permission of a change in position of the extremes and are eliminated behind under compulsion of a shift in position of the extremes. It must be pointed out that an association owes its existence to the complete or partial coincidence of the tolerance ranges of each of the component species. Hence there is no reason to assume that the behavior of an association of species will be controlled by other factors than those controlling the individuals making up the association. The author further states that the mean "characterizes associations." This is dangerously close to saying that the mean may serve as an indicator of the association. The mean of environmental factors is often capable of being expressed in very definite figures, but no one has as yet discovered how these figures can be applied directly with significance to the organism. Its significance is solely as a tool of statistical computation. The problem of extremes in their action on plants is not a statistical problem.

Another point raised by the author concerns the complex problems of the interaction of factors. He points to the environment as being "holocoenotic," meaning that the factors of the environment act collectively and simultaneously. This having been stated, he proceeds to say, "It is erroneous, then, to speak of a single factor as being limiting, quite definitely, the environment is holocoenotic." I will grant that the interaction of factors complicates enormously our analysis of their operation, but I challenge the conclusion that single factors may not be limiting. The farmer in our western states goes to great expense to build an irrigation system. He knows by experience that water is a limiting factor to the plants he is growing. To be sure, water enters into many of the reactions that go on within the plant and is an agent of transport of a complex series of substances which in themselves may at times be limiting, but it is in these very functions that water may be limiting. This does not imply that water works alone nor that the processes are simple nor that any one factor is more important than any other. The fact remains that water, depending on

its availability, may at times be limiting to the successful functioning of the plant.

Carrying the idea of holocoenotic environments further, the author brings in the concept of "compensation" of factors. Here it is presumed that through the interaction of factors an adverse condition of one factor is compensated for by readjustments in the responses to other factors to meet the deficit. One naturally is curious as to how the factor can make its deficit felt to the extent of initiating compensation if a single factor cannot be limiting. In view of the genetic problems so ably discussed by the author, it would seem that the examples of extra-limital distribution used to illustrate compensation cannot be explained on the basis of compensation of factors. It would be necessary to establish beyond a reasonable doubt that the persistence through reproductive activity of any species or group of species in any given habitat is ever extra-limital. It would be more logical to seek an explanation in terms of ecotypes of one sort or another.

Considerable space is devoted to the discussion of recent work in the field of paleobotany and various methods of research are presented. Much of this paleobotanical work has not as yet been sufficiently subjected to scientific scrutiny to be properly evaluated. The author, however, does an excellent job of presenting the material. The chief difficulty is that too few minds have met over the problems involved so that in many cases the ideas expressed in the papers reviewed can scarcely be regarded as mature. In a sense the methods of the paleobotanist tend to make this difficult because the field worker, in collecting a flora, is the only one who sees the record unfold. He alone is present to evaluate the significance of the position of the material in the record. Too often he alone decides what to keep and what to discard. What he keeps often depends upon such factors as transportation and storage facilities. Any further discussion or elaboration of this flora by later workers has imposed upon it the limitations in judgment of the field collector. The preoccupation of many paleontologists with key fossils also has imposed a disastrous handicap on the values of these floras and faunas for geographic and ecologic interpretation.

In the discussion of endemism, it seems to your reviewer that the author begins with a false assumption, namely, that endemics are either youthful species or relics. What about all of those endemics in the prime of their species life that may occupy completely, all of their very specialized potential area? What about this vast array of edaphic species,—an aspect of the problem that to your reviewer seems to be of far greater significance to the general subject of endemism than is the problem of youth and old age? Is it a result of youth or old age that so many Eastern United States endemics are associated with the same ecological factors that cause pine barrens? Is it a consequence of species age that so many Californian endemics are associated with ferro-mag-



nesium rocks? Does age explain why the spectacularly endemic *Cupressus macrocarpa* of the granitic headlands of Carmel Bay stops abruptly at the contact between the Montara granite and the Monterey shale? The fact that the great majority, if not all, of the oceanic islands rich in endemics are made up either of volcanics or are rich in highly mineralized metamorphics is no chance relationship explainable solely on the bases of age and isolation. I do not wish unduly to minimize the role of youth and old age in endemism, but I am suspicious that their rôle may be much less significant than the literature would lead one to suppose. If this relationship between endemics and local habitat is as real as it appears, then such problems may well be explained from the genetic point of view. The logical approach is first to attempt to explain the occurrence of endemics *in situ* in terms of the local habitat and of such genetic phenomena as are so superbly treated in parts four and five of this book. Should this fail, then the gods of theory and logic might be invoked.

I doubt if anything is gained by a definition of endemism that limits the term to distributional patterns of one area. So many of the phenomena of discontinuous distribution are so intimately linked with the causes of endemism that they are inseparable in many of their aspects.

After the able presentation by the author of the various aspects of what, in the past, has been termed the "science of area" and newly christened "areography," I think that we are justified in abandoning many of the ideas expressed in the papers reviewed by the author in this field. They are too irrelevant and on too precarious a scientific foundation. It is a subject in which generalizations are probably futile. This is especially true of many concepts of area and of dispersal and dispersal mechanisms. Distribution is intimately linked with organic processes subject to orderly physiological and physical law. History is the record of the sequence of very definite events in any given area. The vagaries of mass interpretations of area are too great for their safe application to the interaction of these rather complicated phenomena with the events of history.

In reading the discussion of "Evolution and Plant Geography" one cannot escape the feeling that the facts of the nature of species transcend immeasurably the importance of defining species. It would appear that the more one knows about speciation and species behavior the less significant is a definition that could include all types of species. The problems of speciation in the various parts of the plant kingdom are too diverse to permit of such a definition. In this part of the book, as well as in the part dealing with polyploidy, the facts of genetics and polyploidy are so ably treated that it seems almost presumptuous to criticize. Yet the science of plant geography would have been better served had the author summarized frequently in terms of methods of application and values to the plant geographer. For the moment, at least, the plant geographer seems to have been forgotten. To illustrate my point, in the general subject polyploidy, even under the heading "Geographic aspects of polyploidy," nowhere

does the author say in so many words that *the function of polyploidy in plant geography is to provide one of the methods of elaborating the genus and the species over the available habitats*. The geneticist would know that the author understood this rôle, but I doubt if the plant geographer not steeped in genetics would get the point.

In closing, one fact stands out in bold relief. In view of the significance of the 1922 paper of Turesson on the "Genotypical response of the plant species to the habitat" as a beacon light pointing to a common ground of understanding for the taxonomist, the geneticist and the plant geographer, and hence to the new taxonomy and the new plant geography, it is nothing short of amazing that this paper is not discussed in the text nor included in the excellent bibliography.

Regardless of possible differences in point of view, every plant geographer can hail this work as a notable and masterly achievement. It is that type of monument that a man builds to his career that will be enhanced by criticism rather than destroyed by it. The reception this book is bound to receive will serve to congratulate the author far beyond mere words.

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## FIELD TRIPS OF THE CLUB

MAY 19-21, 1944. BRANCHVILLE. The annual Branchville Nature Conference was held at the Haltere Hotel on Culvers Lake jointly with the Newark Museum Nature Club and the Summit Nature Club. The Conference was arranged by Mr. Wallace M. Husk as host and leader of a hike to Stokes Forest. Other leaders included Mr. Herbert Dole, Mr. David Fables, Prof. Julius Johnson, Miss Heyer and Mr. Harold Todd. This year's bird list recorded 86 species, two of them questionable. A plant list of 14 ferns, 4 fern allies, and 135 flowering plants (77 in flower at the time) excluding trees was compiled. Through the generosity of the Summit Club these lists have been mimeographed. A copy is filed with the field committee. At least 25 applications for the Conference had to be refused for lack of available accommodations. The committee must consider moving to a larger hotel or continuing to limit attendance to the accommodations available. We invite suggestions. Attendance 74.

MAY 21. BROOKLYN BOTANIC GARDEN. "A beautiful day and the Garden was at its best. We saw plants of horticultural interest as *Magnolia* and *Azalea* and some of botanical interest as *Eucommia* and *Sinowilsonia*." Leader, Charles Doney. Attendance 5.

MAY 27. MIDVALE, N. J. This was the season's first quest of fungi, and several species were reported by the leader, F. R. Lewis. Attendance 4.